

Notice of Allowability

Application No.

10/601,086

Examiner

Shouxiang Hu

Applicant(s)

WATANABE, YUKIO

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☐ This communication is responsive to ____.
2. ☒ The allowed claim(s) is/are 1-18.
3. ☐ The drawings filed on ____ are accepted by the Examiner.
4. ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some* c) ☐ None of the:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. ____.
3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).
- * Certified copies not received: ____.

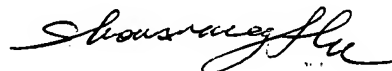
Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.

THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.
6. ☒ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
- (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
- 1) ☐ hereto or 2) ☐ to Paper No./Mail Date ____.
- (b) ☒ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date 20040723.
- Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).
7. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☒ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3. ☒ Information Disclosure Statements (PTO-1449 or PTO/SB/08), Paper No./Mail Date 20030623
4. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
5. ☐ Notice of Informal Patent Application (PTO-152)
6. ☒ Interview Summary (PTO-413), Paper No./Mail Date 20040723.
7. ☒ Examiner's Amendment/Comment
8. ☒ Examiner's Statement of Reasons for Allowance
9. ☐ Other ____.



SHOUXIANG HU
PRIMARY EXAMINER

EXAMINER'S AMENDMENT

An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in a telephone interview with William Wright (RN: 36,312) on July 23, 2004.

The application has been amended as follows:

IN THE CLAIMS

1. (currently amended) A semiconductor light emitting element comprising:
a transparent first conduction type substrate having a first surface and a second surface opposed to each other and being transparent to light of a wavelength λ ;
a semiconductor epitaxial layer ~~formed on~~ or above a location of the first surface of the substrate directly or via a buffer layer, and including a semiconductor layer of a the first conduction type formed in electrical connection with the substrate, an active layer formed on the semiconductor layer of the first conduction type to emit light of the wavelength λ and a semiconductor layer of a second conduction type formed on the active layer;
a first electrode formed in electrical connection with the semiconductor layer of the second conduction type of the semiconductor epitaxial layer on a location of a surface of the semiconductor epitaxial layer opposite from the substrate;
a second electrode formed in electrical connection with the substrate on a location of the second surface of the substrate offset from alignment with the first electrode; and
a groove formed to indent from the second surface of the substrate toward the first surface thereof in a location between the first electrode and the second electrode.

2. (currently amended) A semiconductor light emitting element according to claim 1 wherein the groove has a pass-through surface portion permitting the light from the active layer to pass through ~~externally of~~ leaving the substrate and a reflective surface portion for reflecting light passing through the pass-through surface portion.

3. A semiconductor light emitting element according to claim 1 wherein the groove is wedge-shaped.

4. A semiconductor light emitting element according to claim 1 wherein side surfaces of the semiconductor epitaxial layer are covered with an insulating material.

5. A semiconductor light emitting element according to claim 1 wherein an insulating film is formed on side surfaces of the semiconductor epitaxial layer, a part of the surface of the semiconductor epitaxial layer opposite from the substrate excluding the surface covered with the first electrode, and the first surface of the substrate or the buffer layer.

6. A semiconductor light emitting element according to claim 5 wherein the insulating film is made of a material transparent to light of the wavelength λ from the active layer, and wherein the insulating film is adjusted in thickness to be odd number times of $\lambda/4n$ where n is the refractive index of the insulating film.

~~7. A semiconductor light emitting element according to claim 1 wherein the~~
semiconductor epitaxial layer is formed on a location of the first surface of the substrate via the buffer layer.

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8. A semiconductor light emitting element according to claim 1 wherein the semiconductor layer of the first conduction type, the active layer and the semiconductor layer of the second conduction type included in the semiconductor epitaxial layer are made of InGaAlP compound semiconductor.

9. A semiconductor light emitting element according to claim 1 wherein the substrate is a GaP substrate.

10. (currently amended) A semiconductor light emitting device comprising:
a semiconductor light emitting element having:
a transparent first conduction type substrate having a first surface and a second surface opposed to each other and being transparent to light of a wavelength λ ;
a semiconductor epitaxial layer ~~formed on~~ or above a location of the first surface of the substrate directly or via a buffer layer, and including a semiconductor layer of a the first conduction type formed in electrical connection with the substrate, an active layer formed on the semiconductor layer of the first conduction type to emit light of the wavelength λ and a semiconductor layer of a second conduction type formed on the active layer;
a first electrode formed in electrical connection with the semiconductor layer of the second conduction type of the semiconductor epitaxial layer on a location of a surface of the semiconductor epitaxial layer opposite from the substrate;
a second electrode formed in electrical connection with the substrate on a location of the second surface of the substrate offset from alignment with the first electrode; and
~~a groove formed to indent from the second surface of the substrate toward the first~~
surface thereof in a location between the first electrode and the second electrode;
a reflector; and
an electrically conductive mounting material for mounting the first electrode of the semiconductor light emitting element on the reflector.

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11. (currently amended) A semiconductor light emitting device according to claim 10 wherein the groove has a pass-through surface portion permitting the light from the active layer to pass through ~~externally of~~ leaving the substrate and a reflective surface portion for reflecting light passing through the pass-through surface portion.
12. A semiconductor light emitting device according to claim 10 wherein the groove is wedge-shaped.
13. A semiconductor light emitting device according to claim 10 wherein side surfaces of the semiconductor epitaxial layer are covered with an insulating material.
14. A semiconductor light emitting device according to claim 10 wherein an insulating film is formed on side surfaces of the semiconductor epitaxial layer, a part of the surface of the semiconductor epitaxial layer opposite from the substrate excluding the surface covered with the first electrode, and the first surface of the substrate or the buffer layer.
15. A semiconductor light emitting device according to claim 14 wherein the insulating film is made of a material translucent to light of the wavelength λ from the active layer, and wherein the insulating film is adjusted in thickness to be odd number times of $\lambda/4n$ where n is the refractive index of the insulating film.
16. A semiconductor light emitting device according to claim 10 wherein the ~~semiconductor epitaxial layer further includes a reflective layer of the second conduction type on~~ the semiconductor layer of the second conduction type to reflect light of the wavelength λ .
17. A semiconductor light emitting device according to claim 10 wherein the semiconductor layer of the first conduction type, the active layer and the semiconductor layer of the second conduction type included in the semiconductor epitaxial layer are made of InGaAlP compound semiconductor, and wherein the substrate is a GaP substrate.

18. (currentl y amended) A semiconductor light emitting device comprising:
- a semiconductor light emitting element having:
 - a GaP substrate of a first conduction type, having a first surface and a second surface opposed to each other and being translucent to light of a wavelength λ ;
 - a semiconductor epitaxial layer ~~formed on~~ or above a location of the first surface of the substrate via a buffer layer of a GaP compound semiconductor, and including a semiconductor layer of a the first conduction type formed in electrical connection with the GaP substrate, an active layer formed on the semiconductor layer of the first conduction type to emit light of the wavelength λ , a semiconductor layer of a second conduction type formed on the active layer, a reflective layer of the second conduction type formed on the semiconductor layer of the second conduction type to reflect light of the wavelength λ , and a contact layer of the second conduction type formed on the reflective layer, wherein the semiconductor layer of the first conduction type, the active layer and the semiconductor layer of the second conduction type being made of InGaAlP compound semiconductor and being different in lattice constant and material from the GaP substrate, the contact layer of the second conduction type being made of a GaAs compound semiconductor;
 - a first electrode formed on a location of the contact layer of the second conduction type in electrical connection therewith;
 - a second electrode formed on a location of the second surface of the substrate in electrical connection therewith; and
 - a wedge-shaped groove formed to indent from the second surface of the substrate toward the first surface thereof in a location between the first electrode and the second electrode, and having a pass-through surface portion permitting the light ~~frø~~ from the active layer to pass through ~~externally of~~ leaving the substrate and a reflective surface portion for reflecting light passing through the pass-through surface potion;
 - a reflector; and
 - an electrically conductive mounting material for mounting the first electrode of the semiconductor light emitting element on the reflector.

Allowable Subject Matter

Claims 1-18 are allowed.

Reasons for Allowance

The following is an examiner's statement of reasons for allowance: Prior art does not teach or render obvious a semiconductor light emitting element as defined in the above allowed claims, comprising particularly: a diode-type light emitting structure on and in electric contact with a first main surface of a transparent first conductive type substrate; a first electrode for the light emitting element formed in electrical contact with the diode-type light emitting structure through a surface of the light emitting structure opposing the substrate; and a second electrode for the light emitting element formed in electrical contact with a second main surface of the substrate opposing the first main surface, wherein a groove formed to indent from the second main surface of the substrate toward the first main surface of the substrate in a location between the first electrode and the second electrode.

Drawings

Figures 20 and 21 are objected to as they should be designated by a legend such as --Prior Art-- because only that which is old is illustrated. See MPEP § 608.02(g). Corrected drawing sheets are required in reply to the Office action to avoid abandonment of the application. The replacement sheet(s) should be labeled "Replacement Sheet" in the page header (as per 37 CFR 1.84(c)) so as not to obstruct

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any portion of the drawing figures. If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. References A-E are cited as being related to a light emitting device structure.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Shouxiang Hu whose telephone number is 571-272-1654. The examiner can normally be reached on Monday through Thursday, 7:30 AM to 6:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eddie C. Lee can be reached on 571-272-1732. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

SH
July 23, 2004


SHOUXIANG HU
PRIMARY EXAMINER